TYPE I Report #4 for ERTS Contract No. S-70251-AG, Task 3 (431-641-14-01-07) for the period June 19 - August 19, 1973.

a. Title of Investigation: Reflectance of Vegetation, Soil, and Water

b. GSFC ID: AG 339

c. Objective of the Contract:

The seasonal changes in reflectance of various soils and of various crops grown in Hidalgo County, Texas, are being studied using ERTS-1, ground, and aircraft spectral data. Discrimination of specific crop and soil conditions is being attempted; chlorophyll content of plant leaves will be correlated with reflectance in the visible channels, and comparisons are being made between ERTS data and predictions from analytical models describing interaction of light with plant canopies.

d. Statement of Problems in the Report Period:

Only minor problems have been encountered. The absence of data every sixth scan line in the CCT for channel 6 in the January 21, 1973 (2537-16322) satellite overpass has caused some complications in statistical and pattern recognition programs.

Ordering of CCT for aircraft support flights would be facilitated if there were a standard procedure for testing data quality from each of the 24 channels of the MSS and for informing investigators of this information by the time they are ready to order digital products.

The range in digital counts from each of the ERTS MSS channels is quite narrow. In addition, the wavelength interval covered by the sensors is narrow. Evidently the signals are being dominated by the optically flat soil background. In future satellites a wider range of wavelengths should be incorporated into the scanners and if possible, a wider dynamic range in sensor signals should be provided.

Data Processing Progress

Three sets of digital data are currently being processed from ERTS CCT at Weslaco, Texas. Two sets of digital CCT are from satellite overpasses on December 16, 1972 and January 21, 1973. The third set of digital CCT is from ERTS aircraft support Mission 226 on January 21, 1973. Since the last Type II Report (December 19, 1972-June 19, 1973) data processing has been concerned with locating all possible experimental segments (out of 197 segments in Hidalgo County), in accord with the Weslaco Data Analysis Plan, on the ERTS CCT and storing these digital data on secondary tapes for later analysis. The data processing status, as of August 19, 1973, is shown in Table 1.

Location of the December 16, 1972 satellite data is finished except for editing experimental site (segments) coordinates that are punched on computer cards to be sure that digital data is stored on the secondary tape correctly. As can be seen from Table 1, 159 segments, out of 197, have been located and stored on secondary magnetic tapes (1262 out of 1443 fields) and are ready for final data analysis. Of the 38 missing segments (181 fields) 9 were under clouds, 3 were not on any CCT, 2 were split between two CCT, and 24 were not locatable (could not determine segment boundary).

Table 1. Data processing status for three sets of ERTS CCT. Two sets of CCT data are from satellite imagery (December 16, 1972; January 21, 1973) and one set is from aircraft support Mission 226 (January 21, 1973).

Data processing status	Satellite data sets				Aircraft data sets	
	12-16-73		1-21-73		1-21-73	
	Fields	Segments	Fields	Segments	Fields	Segments
Total located	1262	159	990	135	87	13
Total missing	181	38	451	62	18	5
-Under clouds	75	9	-	-	-	-
-Not on CCT	3	3	-	-	10	1
-Split between CCT	4	2	-	-	-	-
-Cannot locate on gray maps	99	24	-	-	-	-
-Processing not complete	-	-	451	62	8	4
Total	1443	197	1441	197	105	18

For the January 21, 1973 satellite data 135 segments out of 197 have been located (990 out of 1441 fields). Of the 62 missing segments (451 fields) a complete status breakdown is not available because processing is not complete. The final count for the January data should be better than for December because of a clearer atmosphere at the time of the January overpass.

Out of the 18 segments (105 fields) on the ERTS aircraft support Mission 226 flight lines 13 have been located (87 fields) and 5 are missing (18 fields). One of the 5 missing segments is not on the CCT; the other 4 have not been processed but no problem is anticipated in locating these segments. The final count for the aircraft segments should be 17 (95 fields).

Data processing of the December and January satellite data should be complete within the next two weeks. Data analysis for these data will extend over another 4 to 6 week period, after that. Data processing of the aircraft data will be finished this week and data analysis should be complete within 1 to 2 weeks after that.

Acreage Estimates for Cotton, Citrus, and Sorghum for Crop Year 1973

Acreage data have been compiled for all the cotton, sorghum, citrus, rangeland, and improved pastures found in the 197 segments used for ground truth. The 197 segments comprise approximately 40,000 acres. The citrus was considered in three categories--oranges, grapefruit, and mixed (plantings of more than one variety in an orchard).

Table 2 lists acreages for each crop by interpenetrating sample series. The total acreage for each crop is also given. Estimates on a county-wide basis were calculated from the interpenetrating sample series acreage using instructions supplied by the SRS. To estimate the acreage of cotton, for example, acreage for each of the 1000 to 4000 series was multiplied by 91.3256 (the factor supplied by SRS). The grand total of the four series was then divided by four to yield the County estimate, 129,714 acres, shown in Table 2. Table 2 gives the County estimate in acres for each crop considered. The estimates include the farmable land devoted to turnrows.

A study was made on a few selected segments to determine the amount of farmable land devoted to turnrows for certain crops. On the average, 8.18% of the area in cotton fields was devoted to turnrows. Not enough data were available to determine the percentage for sorghum and citrus. The small amount of data available for sorghum suggested that, on the average, 8% of the field was used for turnrows. The acreage estimate for cotton of 129,714 acres reduced by the 8.18% used for turnrows leaves an estimated 119,103 acres actually planted in cotton.

Table 2. Acreages devoted to various crops and land uses in Hidalgo County in 1973 as ground truthed in four interpenetrating sample series and the resultant estimate for the whole County.

CROP	SERIES 1000	2000	3000	4000	COUNTY ESTIMATE
	- - - - - - - - Acres - - - - - - - -				
Cotton	1170.36	1256.89	1537.35	1716.77	129,714
Sorghum	1070.87	1277.43	3220.59	2436.87	182,783
Mixed Citrus	792.91	717.17	461.98	391.09	53,954
Oranges	287.82	166.36	86.93	200.35	16,929
Grapefruit	145.33	85.15	192.27	184.42	13,863
Rangeland	3596.17	2629.46	2515.41	2867.86	137,845
Improved pastures	848.95	2616.11	392.11	774.09	57,169

f. Significant Results and Practical Applications:

A ratio of MSS channels 5 and 7 (5/7) and 5 to 6 (5/6) signals resulted in a correct recognition of 86.9% of the members of representative crop and soil conditions, compared with recognitions of 60.0, 64.1, 74.1, and 81.4% for channels 4, 5, 6, and 7 taken individually. Based on this result a satellite channel ratio procedure has been developed that enhances line printer gray maps for more efficient experimental test site location in the CCT data.

Because independent estimates are not available to judge acreage estimates derived from ERTS-1 data against, except for a few crops, an interpenetrating sample constituting 3.5% of the County is ground truthed periodically. The crop or land uses and their acreages, respectively, as estimated from the interpenetrating samples, are: cotton, 129,714; sorghum, 182,783; mixed citrus, 53,954; oranges, 16,929; grapefruit, 13,863; rangeland, 137,845; and, improved pastures, 57,169.

g. Publications:

Richardson, A. J., M. R. Gautreaux, and C. L. Wiegand. ERTS-1 aircraft support, 24-channel CCT experiences and land use classification results. Proc. Conf. Machine Processing of Remotely Sensed Data. LARS Purdue, Oct. 16-18, 1973. (In Press).

h. Recommendations Concerning Changes in Operations, Additional Investigations, Efforts, and Effort/Results as Related to the ERTS System:

See section, "Problems in the Report Period" for recommendations.

i. Changes in Standard Order Forms:

None.

j. ERTS Image Descriptor Form:

Attached.

k. Changes in Restrospective Data Requests:

None.

l. Planned Work for the Next Reporting Period:

During the next reporting period analyses of the CCT from the December 16, 1972 (1146-16323) overpass will be completed. Data preprocessing in progress on the January 21, 1973 (2537-16322) overpass will be completed and detailed analysis will begin.

Aircraft mission 226 was flown on January 21 simultaneously with the overpass of ERTS-1. CCT from this mission are in hand and work on them will continue using data from 17 sample segments. The types of work to be done include: select optimal channels for crop and soil discrimination; compare aircraft and ERTS-1 responses for comparable wavelengths; determine percent recognition of all fields in the 17 segments using both ERTS-1 and aircraft data.

The relations between ground truth (percent plant cover, soil type, plant height, planting configuration [plant density], soil surface conditions, etc.) and MSS digital counts will be investigated more thoroughly in order to determine the degree to which MSS digital counts can be predicted from ground truth.

Statistical estimates of the acreages devoted to the winter vegetables will be obtained periodically as fall planting progresses.

If the CCT from the May ERTS-1 coverage are received the next reporting period, data from fields of high interest--those in which leaf area index and chlorophyll content of crops were measured--will be extracted from the data.

b

ERTS IMAGE DESCRIPTOR FORM

PRINCIPAL INVESTIGATOR Craig L. Wiegand

DATE August 19, 1973

USER ID AG 339

AGENCY USDA-ARS

PRODUCT ID (Include Band and Product)	Frequently Used Descriptors *				DESCRIPTORS
	COAST	CROPLAND	RANGELAND	LAKE	
3290-16323-5	X		X		
3290-16325-5		X			Clouds
3304-16381-5			X		
3304-16383-5			X	X	
3541-16323-5	EEO	X	X		
3541-16325-5			X		Clouds
3555-16381-5			X		
3792-16322-5					Clouds
3792-16325-5					Clouds
3806-16383-5					Clouds
4043-16321-5	X				Clouds
4043-16324-5					Clouds
4057-16380-5					Clouds
4294-16320-5	X				Clouds
4294-16323 5	X	X	X		
4545-16315-5					Clouds

*For Descriptors which will occur frequently, write the descriptor terms in these column heading spaces now and use a check (✓) mark in the appropriate ID lines. (For other descriptors, write the term under the DESCRIPTORS column).

MAIL TO ERTS User Services
Code 563 413
Bldg 23 Room E255
NASA GSFC
Greenbelt, Md. 20771